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(11)Publication number : 2000-194855

(43)Date of publication of application : 14.07.2000

(21)Application number : 10-368409

(22)Date of filing : 25.12.1998

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(54) Name of the invention: INDIVIDUAL IDENTIFICATION DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To reduce the burdens of photographing the image of an eye at the collation, thereby performing the collation in a short time.

SOLUTION: The size of the pupil of the eye is changed by gently changing the intensity of illumination with time by visible light illumination 12 and the plural images of the eye for which the size of the pupil is different are successively photographed by an infrared ray video camera 13. The feature is extracted by a feature extraction part 15 from the photographed plural images of the eye 1 and extracted plural feature data are registered for respective individuals. Then, in photographing the image of the eye to be collated, one image of the eye is acquired and the feature data and the registered plural images of the eye for the respective individuals are collated.

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the individual discernment system which analyzes the description of the image of the eye containing a pupil and the iris, collates the analyzed description data, and performs individual discernment.

[0002]

[Description of the Prior Art] Conventionally, the individual discernment technique of analyzing the iris of the image of the eye containing a pupil and the iris, collating the analyzed iris data, and performing individual discernment is known. As this kind of an individual discernment technique, the iris recognition system of JP,5-84166,B is reported, for example. In this iris recognition system, the light source of the lighting means 70 is adjusted and the image of two or more eyes with which the dimensions of a pupil differ is photoed with a camera 84. It is compared with the storage image of the eye 10 with the respectively same dimension of a pupil of the input image of two or more eyes 10 from which the dimension of a pupil differs with the comparison means 90 at

the time of collating of an eye.

[0003]

[Problem(s) to be Solved by the Invention] However, there were the following technical problems which should be solved in the above-mentioned conventional technique. Since a certain amount of time amount was needed in order to illuminate an eye with a lighting means and to change a pupil to desired magnitude, there was a problem that photography of an eye took time amount. Moreover, since it was difficult to make an animal stand it still when photoing the image of the eye of animals other than human beings, such as a horse, it was difficult to obtain the good image the focus suited and the eye has turned [image] to the transverse plane, and there was a case where a photograph had to be retaken from the beginning for a flameout, further. Therefore, time amount will cut to photography of an eye further. By the way, the time of registering the iris data of an eye and the time of collating the iris data of an eye photo the image of an eye. Generally there are many opportunities of collating to a thing with few opportunities of registration. Then, even if it took some time amount of registration, individual discernment system implementation which can shorten time amount of collating as much as possible was desired.

[0004]

[Means for Solving the Problem] The next configuration is used for this invention in order to solve the above-mentioned technical problem.

<Claim 1> The lighting section to which invention according to claim 1 changes the reinforcement of lighting proportionally with time, and the magnitude of the pupil of an eye is changed, The image pick-up section which photos the image of two or more eyes with which the magnitude of the pupil illuminated by the above-mentioned lighting section differs, The feature-extraction section which extracts the description of the image of two or more eyes photoed by the above-mentioned image pick-up section, It is characterized by having the collating unit which collates the description data of the image of the eye which should be collated with the registration equipment which has the registration section which registers the description data of the image of two or more eyes extracted by the above-mentioned feature-extraction section using the description data of the image of two or more eyes registered into the above-mentioned registration section.

[0005] In invention according to claim 1, in registration equipment, the reinforcement of the lighting of the lighting section is changed proportionally with time, and the magnitude of the pupil of an eye is changed. The image of two or more eyes with which the magnitude of the pupil illuminated by the lighting section differs is photoed by the

photography section. The description of the image of two or more photoed eyes is extracted by the feature-extraction section, and the description data of the image of two or more extracted eyes are registered into the registration section. In a collating unit, the description data of the image of the eye which should be collated are collated using the description data of the image of two or more eyes registered into the above-mentioned registration section.

[0006] For this reason, since the image of an eye with which the magnitude of a pupil is gently changed and the magnitude of a pupil differs can be photoed without controlling a pupil in desired magnitude one by one, the image of an eye can be photoed easily. Moreover, there is individual difference in the reinforcement of the lighting with which a pupil may change rapidly near the reinforcement of lighting with that magnitude, and this abrupt change happens. For this reason, when the reinforcement of lighting is changed rapidly, the magnitude of a pupil also changes rapidly and has a possibility that the image of the eye of the pupil of various magnitude cannot acquire. For this reason, by changing the reinforcement of lighting proportionally with time, since the magnitude of a pupil can be changed gently, the pupil of various magnitude is certainly acquirable. Furthermore, what is necessary is to acquire the image of the eye of one sheet and just to collate the description data and the image of two or more eyes for every registered individual, when photoing the image of the eye which should be collated. Therefore, since the burden of photography of the image of the eye at the time of collating is mitigable, the individual discernment system which can collate in a short time can be offered.

[0007] <Claim 2> Invention according to claim 2 is characterized by the above-mentioned lighting section enlarging reinforcement of lighting in proportion to elapsed time in invention according to claim 1.

[0008] The above-mentioned lighting section consists of invention according to claim 2 so that reinforcement of lighting may be enlarged in proportion to elapsed time. Thereby, since magnitude of a pupil can be made small in proportion to the reinforcement of lighting, the magnitude of a pupil can be changed gently. Moreover, if reinforcement of lighting is enlarged further, a pupil will be in the saturation state which does not become small any more. Moreover, if a pupil will be in a saturation state, even if it makes reinforcement of lighting small, returning to the original magnitude will once take time amount. For this reason, the magnitude of a pupil can photo the image of a variously different eye efficiently by enlarging reinforcement of lighting gradually from the condition that lighting put out the light.

[0009] <Claim 3> Invention according to claim 3 is set to invention according to claim 1.

The description part of the image of the eye photoed by the above-mentioned image pick-up section is detected, and it has the image judging section which judges the quality of the image of the eye concerned based on this detection result. The above-mentioned lighting section When reinforcement of lighting is enlarged in proportion to subsequent elapsed time when the above-mentioned image judging section judges that the image of an eye is good, and the above-mentioned image judging section judges that the image of an eye is poor, it is characterized by making reinforcement of lighting small in proportion to subsequent elapsed time.

[0010] In invention according to claim 3, the description part of the image of the eye photoed by the above-mentioned image pick-up section is detected, and the quality of the image of the eye concerned is judged by the image judging section based on this detection result. In the above-mentioned lighting section, when reinforcement of lighting is enlarged in proportion to subsequent elapsed time when the above-mentioned image judging section judges that the image of an eye is good, and the above-mentioned image judging section judges that the image of an eye is poor, reinforcement of lighting is made small in proportion to subsequent elapsed time.

[0011] Since it is difficult to make an animal stand it still when photoing the image of the eye of animals other than human beings, such as a horse, the description part of eyes, such as a pupil, the iris, and iris granulation, may overflow a photography field, or an image may fade. For this reason, by detecting the description part of the image of an eye, a flameout, dotage of an image, etc. are detected and the quality of the image of an eye is judged. And when it judges that the image of an eye is good, reinforcement of lighting is enlarged in proportion to elapsed time, and the image of an eye with which a pupil becomes small gradually is photoed one by one. On the other hand, when it judges that the image of an eye is poor, reinforcement of lighting is made small in proportion to elapsed time, a pupil is enlarged again, and photography of an eye is redone. For this reason, since a photograph can be continuously taken, without retaking a photograph from the beginning even when it judges that an image is poor for the reasons of a flameout etc., the exposure time of an eye can be shortened.

[0012] Moreover, reinforcement of lighting can be made small in proportion to subsequent elapsed time, and a pupil can be enlarged gradually. For this reason, it can prevent that a pupil becomes large beyond the need, and the part into which the magnitude of a pupil overlaps and photos the image of the same eye can be lessened. Therefore, the magnitude of a pupil can photo the image of the eye of a variously different animal efficiently.

[0013] <Claim 4> The non-light lighting section to which invention according to claim 4

irradiates the non-light at an eye, The light lighting section to which the magnitude of the pupil of the above-mentioned eye which the light was changed proportionally with time, was irradiated at the above-mentioned eye, and was irradiated [light] in the reinforcement is changed, The non-visible-ray image pick-up section which photos the image of two or more eyes with which the magnitude of the pupil at which the light was irradiated by the above-mentioned light lighting section differs in a non-light band, The feature-extraction section which extracts the description of the image of two or more eyes photoed by the above-mentioned non-visible-ray image pick-up section, It is characterized by having the collating unit which collates the description data of the image of the eye which should be collated with the registration equipment which has the registration section which registers the description data of the image of two or more eyes extracted by the above-mentioned feature-extraction section using the description data of the image of two or more eyes registered into the above-mentioned registration section.

[0014] In the light lighting section, in invention according to claim 4, the light is irradiated to the non-light by the eye by the non-light lighting section in registration equipment. At this time, the light of the light lighting section changes that reinforcement proportionally with time, and the magnitude of the pupil of an eye changes. The image of two or more eyes with which the magnitude of a pupil differs is photoed by the non-visible-ray image pick-up section in a non-light band. The description of the image of two or more photoed eyes is extracted by the feature-extraction section, and the description data of the image of two or more extracted eyes are registered into the registration section. In a collating unit, the description data of the image of the eye which should be collated are collated using the description data of the image of two or more eyes registered into the above-mentioned registration section.

[0015] Therefore, since an eye can be illuminated by the non-light of the non-light lighting section so that the reinforcement of the lighting of the uninfluential light lighting section may be changed to the image photoed by the non-visible-ray image pick-up section, the magnitude of the pupil of an eye may be changed and a good image may be photoed by the non-visible-ray image pick-up section, by the non-visible-ray image pick-up section, it is stabilized and a good image can be photoed.

[0016]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained with reference to a drawing.

<<example 1>>

<Configuration> Drawing 1 is individual discernment structure of a system drawing of the example 1 concerning this invention. As shown in drawing 1, this individual discernment system is equipped with the infrared lighting 11, the light lighting 12, the infrared video camera 13, the image pick-up control section 14, the feature-extraction section 15, the registration section 16, and the collating section 17.

[0017] This individual discernment system has the function (collating mode) of a collating unit collate the description data of the function (register mode) of registration equipment photo the eye of the animal containing a pupil and the iris, and register the description of the image of the photoed eye, and the inputted image of an eye with the description data registered by said registration equipment, and perform individual discernment. The individual discernment system of this invention has the description in the function of registration equipment. In addition, as an animal, animals, such as a horse, a cow, a goat, a sheep, a dog, and a cat, are set as the object of individual discernment at everybody but human being.

[0018] The infrared lighting 11 and the light lighting 12 illuminate the eye 1 for photography, respectively. The infrared lighting 11 is used in order to obtain the good image of contrast. This infrared lighting 11 is suitable as the light source of the wavelength which is hard to sense to an animal in order to avoid that an animal reacts superfluously. The light lighting 12 is used in order to change the reinforcement of light lighting and to change the magnitude of the pupil 2 of an eye 1.

[0019] The infrared video camera 13 photos continuously the image of two or more eyes 1 with which the magnitude of the pupil illuminated by the light lighting 12 differs. Since the infrared video camera 13 photos the reflected light of an infrared field, there is no effect in the image photoed even if it changes the reinforcement of light lighting with the light lighting 12. The image pick-up control section 14 controls the infrared lighting 11, the light lighting 12, and the infrared video camera 13. The image pick-up control section 14 has the timer which is not illustrated inside, and enlarges reinforcement of the lighting of the light lighting 12 in proportion to exposure time using this timer at the time of register mode. It is for not changing reinforcement of lighting rapidly to make it be proportional to exposure time. For example, also when changing the reinforcement of lighting gradually, if it is proportionally macroscopically, it is contained "proportionally." What contains the part which changes rapidly like an exponential function or a secondary function is not contained in "proportional" semantics.

[0020] The feature-extraction section 15 extracts the description of the image of two or more eyes 1 that the magnitude of the pupil 2 photoed with the infrared video camera 13 differs, respectively. The description of an eye 1 can be acquired from a pupil 2 and

the iris 3. Moreover, in the case of a horse, a cow, a goat, the sheep, etc., it can also obtain from the iris granulation which is not illustrated besides a pupil 2 and the iris 3. Two or more description data extracted by the feature-extraction section 15, respectively are registered into the registration section 16. The description data of these plurality are registered for every individual.

[0021] The collating section 17 collates the description data (the input description data) of the input image of the eye which should be collated using two or more description data (the registration description data) for every individual registered into the registration section 16. It judges with the individual of the input description data and the individual of the collating section 17 applicable to the registration description data having corresponded, when the input description data and the registration description data were in agreement within the deflection set up beforehand for example.

[0022] <Actuation> Drawing 2 is the explanatory view of the light lighting at the time of register mode of operation. The lighting of an eye 1 is started by the infrared lighting 11 and the light lighting 12, and photography of the eye 1 of the infrared video camera 13 is started simultaneously. The reinforcement of the light lighting of the light lighting 12 becomes large in proportion to the exposure time of an eye 1 to the reinforcement of the lighting of the infrared lighting 11 being fixed.

[0023] At the time of the photography time of day 0, a putting-out-lights condition has the light lighting 12, and the reinforcement is 0. At this time, the pupil 2 of an eye 1 serves as max. If the reinforcement of the light lighting of the light lighting 12 becomes large in proportion to exposure time, the pupil 2 of an eye 1 will become small in proportion to it. If time of day T0 comes, a pupil 2 will reach the saturation state which does not become small any more. Photography is completed at the time of day T1 when this saturation state was checked by the photography person. In the meantime, the image of two or more eyes 1 from which the magnitude of a pupil 2 differs with the infrared video camera 13 is photoed continuously. In the feature-extraction section 15, the description is extracted from the image of two or more eyes 1 photoed with the infrared video camera 13, and two or more extracted description data are registered into the registration section 16 for every individual.

[0024] <Effectiveness> As mentioned above, according to the individual discernment system of an example 1, the reinforcement of lighting is gently changed with time with the light lighting 12, the magnitude of the pupil of an eye is changed gently, and the image of two or more eyes with which the magnitude of a pupil differs is continuously photoed with the infrared video camera 13. And the feature-extraction section 15 extracts the description from the image of two or more photoed eyes 1, and two or more

extracted description data are registered for every individual.

[0025] For this reason, the image of two or more eyes with which the magnitude of a pupil differs can be photoed continuously, without controlling a pupil in desired magnitude one by one. There is individual difference in the reinforcement of the lighting with which magnitude may change rapidly [a pupil] near the reinforcement of a certain lighting, and this abrupt change happens. For this reason, when the reinforcement of lighting is changed rapidly, the magnitude of a pupil also changes rapidly and has a possibility that the image of the eye of the pupil of various magnitude cannot acquire by one photography. Therefore, the image of two or more eyes with which the magnitude of a pupil differs can be photoed easily.

[0026] If reinforcement of the lighting of the light lighting 12 is enlarged, the pupil will become small and will be in a saturation state. If a pupil will be in a saturation state, even if it makes reinforcement of lighting small, becoming large will once take time amount. For this reason, in order for the magnitude of a pupil to photo the image of a variously different eye efficiently, it is desirable to enlarge reinforcement of lighting gradually from the condition that lighting put out the light.

[0027] Furthermore, when photoing the image of the eye which should be collated, the image of the eye of one sheet can be acquired and the description data and the description data of the image of two or more eyes for every registered individual can be collated. Therefore, since the burden of photography of the image of the eye at the time of collating is mitigable, the individual discernment system which can collate in a short time can be offered.

[0028] Moreover, while changing the reinforcement of the light lighting with the light lighting 12 and changing the magnitude of the pupil 2 of an eye 1, an eye is illuminated with the infrared light lighting of the infrared lighting 11, and the image of the eye 1 of an infrared band is photoed with the infrared video camera 13. Therefore, the reinforcement of uninfluential light lighting is changed to the image photoed with the infrared video camera 13, since an eye 1 can be illuminated with the infrared lighting 11 so that a good image may be obtained with the infrared video camera 13, with the infrared video camera 13, it is stabilized and a good image can be photoed.

[0029] <<example 2>>

<Configuration> In the individual discernment system of an example 1, reinforcement of the lighting of the light lighting 12 was enlarged in proportion to exposure time, and the image of two or more eyes with which the magnitude of a pupil differs was photoed. However, since it is difficult to make an animal stand it still when photoing the eye of animals other than human beings, such as a horse, dotage of a flameout and an image

occurs and the case where a photograph must be retaken from the beginning can be considered. In addition, a flameout means that the object for photography overflows the photography field of a camera. So, in the individual discernment system of an example 2, the image judging section 18 which judges the quality of the image of the eye photoed with the infrared video camera 13 was formed, and it carried out to changing the reinforcement of the lighting of the light lighting 12 gently based on the judgment result of this image judging section 18.

[0030] Drawing 3 is individual discernment structure of a system drawing of the example 2 concerning this invention. As shown in drawing 3, the individual discernment system of an example 2 forms the image judging section 18 in the image pick-up control section 14 of the individual discernment system of an example 1.

[0031] The image judging section 18 detects the description part of the image of the eye 1 photoed with the infrared video camera 13, and judges the quality of the image of the eye 1 concerned based on this detection result. The image judging section 18 detects the pupil 2 and the iris 3 of an eye 1 from the concentration change in an image, and when it is undetectable these any they are, it judges with the image of an eye being faulty. Moreover, the image judging section 18 judges with the image of an eye being faulty, when dotage of an image is detected from the provincial accent of the edge part of an image and dotage of an image is detected. In addition, the description part of the image of an eye 1 is not restricted to a pupil 2 and the iris 3, and, in the case of a horse, iris granulation can also become the description part.

[0032] The image pick-up control section 14 makes reinforcement of lighting small in proportion to subsequent exposure time, when reinforcement of the lighting of the light lighting 12 is enlarged in proportion to subsequent exposure time when the image judging section 18 judges that the image of an eye 1 is good, and the image judging section 18 judges that the image of an eye 1 is poor. In addition, other each part is the same configuration as each part of the individual discernment system of an example 1, and omits the explanation.

[0033] <Actuation> Drawing 4 is the explanatory view of the light lighting at the time of register mode of operation. The lighting of an eye 1 is started by the infrared lighting 11 and the light lighting 12, and photography of the eye 1 of the infrared video camera 13 is started simultaneously. The reinforcement of the light lighting of the light lighting 12 becomes large in proportion to the exposure time of an eye 1 to the reinforcement of the lighting of the infrared lighting 11 being fixed. Simultaneously, in the image judging section 18, the description part of the image of the eye 1 photoed with the infrared video camera 13 is detected, and the quality of the image is judged.

[0034] At the time of the photography time of day 0, a putting-out-lights condition has the light lighting 12, and the reinforcement is 0. At this time, the pupil 2 of an eye 1 serves as max. If the reinforcement of the light lighting of the light lighting 12 becomes large in proportion to exposure time, the pupil 2 of an eye 1 will become small in proportion to it.

[0035] If the image judging section 18 judges that the image photoed with the infrared video camera 13 at time of day Ta - time of day Tb is poor at time of day Tc from the reasons of a flameout etc., reinforcement of the lighting of the light lighting 12 will be made small by the image pick-up control section 14 in proportion to subsequent elapsed time. The pupil 2 which became small once becomes large again.

[0036] Reinforcement of lighting is made small for enlarging a pupil gradually in proportion to subsequent elapsed time. There is individual difference in the reinforcement of the lighting with which magnitude may change rapidly [a pupil] near the reinforcement of a certain lighting, and this abrupt change happens. For this reason, it is because a pupil may become large beyond the need if reinforcement of lighting is rapidly made small. Since the part into which the magnitude of a pupil overlaps and photos the image of the same eye can be lessened by this after the image judging section 18 judges that an image is good again, the magnitude of a pupil can photo the eye of a variously different animal efficiently.

[0037] Then, at time of day Td, if the image judging section 18 judges that an image is good, reinforcement of the lighting of the light lighting 12 will be again enlarged by the image pick-up control section 14 in proportion to subsequent elapsed time. A pupil 2 becomes small again. Then, if time of day T0 comes, a pupil 2 will reach a saturation state. After this saturation state is checked by the photography person, photography is completed in time of day T1. In the meantime, the image of two or more eyes 1 from which the magnitude of a pupil 2 differs with the infrared video camera 13 is photoed continuously. In the feature-extraction section 15, the description is extracted from the image of two or more eyes 1 photoed with the infrared video camera 13, and two or more extracted description data are registered into the registration section 16 for every individual.

[0038] <Effectiveness> As mentioned above, according to the individual discernment system of an example 2, the image judging section 18 is formed, the description part of the image of the eye photoed with the infrared video camera 13 is detected, and the quality of the image of the eye concerned is judged based on this detection result. And when the image judging section 18 judges that the image of an eye is good, reinforcement of the lighting of the light lighting 12 is enlarged in proportion to

subsequent elapsed time by the image pick-up control section 14, and the image of an eye with which a pupil becomes small gradually is photoed one by one. On the other hand, when the image judging section 18 judges that the image of an eye is poor, reinforcement of lighting is made small in proportion to subsequent elapsed time, and a pupil is enlarged again. For this reason, since a photograph can be continuously taken, without retaking a photograph from the beginning even when it judges that an image is poor for the reasons of a flameout etc., the exposure time of an eye can be shortened.

[0039] Moreover, reinforcement of lighting is made small in proportion to subsequent elapsed time, and a pupil is enlarged gradually. For this reason, it can prevent that a pupil becomes large beyond the need, and the part into which the magnitude of a pupil overlaps and photos the same eye can be lessened. Therefore, the magnitude of a pupil can photo the image of the eye of a variously different animal efficiently.

[0040] Thus, since the description data of the image of an eye with which the magnitude of a pupil differs variously can be registered, the individual discernment system of this invention can be suitably used also in the environment of the outdoors where brightness changes with a season or weathers, for example.

[Brief Description of the Drawings]

[Drawing 1] It is individual discernment structure of a system drawing of the example 1 concerning this invention.

[Drawing 2] It is the explanatory view of the light lighting at the time of register mode of operation.

[Drawing 3] It is individual discernment structure of a system drawing of the example 2 concerning this invention.

[Drawing 4] It is the explanatory view of the light lighting at the time of register mode of operation.

[Description of Notations]

1 Eye

2 Pupil

3 Iris

11 Infrared Lighting

12 Light Lighting

13 Infrared Video Camera

14 Image Pick-up Control Section

15 Feature-Extraction Section

16 Registration Section

17 Collating Section

18 Image Judging Section

[Claim(s)]

[Claim 1] The lighting section to which the reinforcement of lighting is proportionally changed with time, and the magnitude of the pupil of an eye is changed, The image pick-up section which photos the image of two or more eyes with which the magnitude of the pupil illuminated by said lighting section differs, The feature-extraction section which extracts the description of the image of two or more eyes photoed by said image pick-up section, The registration equipment which has the registration section which registers the description data of the image of two or more eyes extracted by said feature-extraction section, The individual discernment system characterized by having the collating unit which collates the description data of the image of the eye which should be collated using the description data of the image of two or more eyes registered into said registration section.

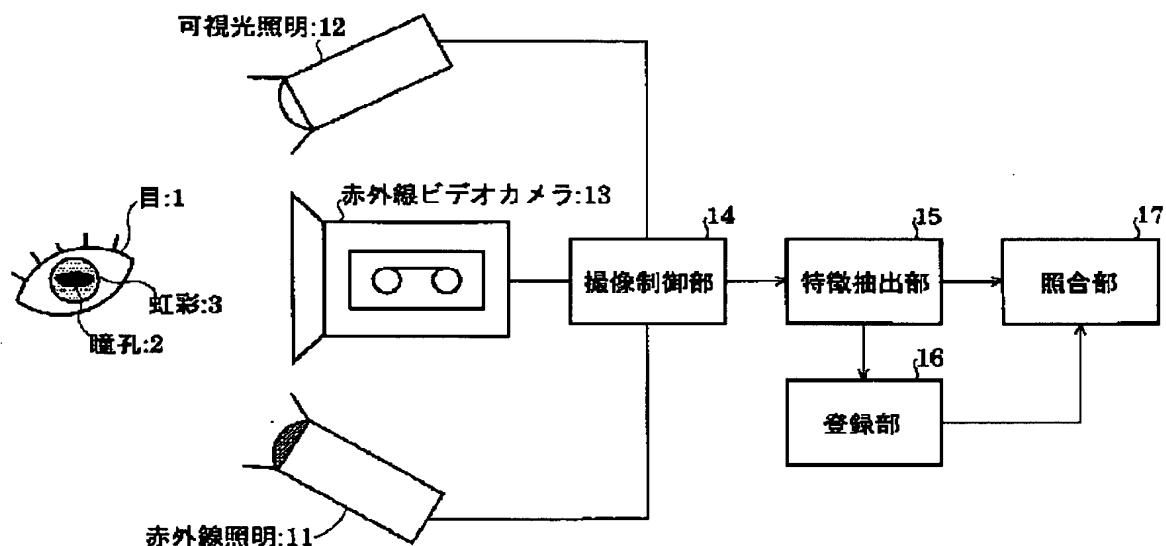
[Claim 2] It is the individual discernment system characterized by said lighting section enlarging reinforcement of lighting in proportion to elapsed time in an individual discernment system according to claim 1.

[Claim 3] In an individual discernment system according to claim 1, the description part of the image of the eye photoed by said image pick-up section is detected. It has the image judging section which judges the quality of the image of the eye concerned based on this detection result. Said lighting section The individual discernment system characterized by making reinforcement of lighting small in proportion to subsequent elapsed time when reinforcement of lighting is enlarged in proportion to subsequent elapsed time when said image judging section judges that the image of an eye is good, and said image judging section judges that the image of an eye is poor.

[Claim 4] The light lighting section to which the magnitude of the pupil of the non-light lighting section which irradiates the non-light at an eye, and said eye which the light was changed proportionally with time, was irradiated at said eye, and was irradiated [light] in the reinforcement is changed, The non-visible-ray image pick-up section which photos the image of two or more eyes with which the magnitude of the pupil at which the light was irradiated by said light lighting section differs in a non-light band, The feature-extraction section which extracts the description of the image of two or more eyes photoed by said non-visible-ray image pick-up section, The registration equipment which has the registration section which registers the description data of the image of two or more eyes extracted by said feature-extraction section, The individual

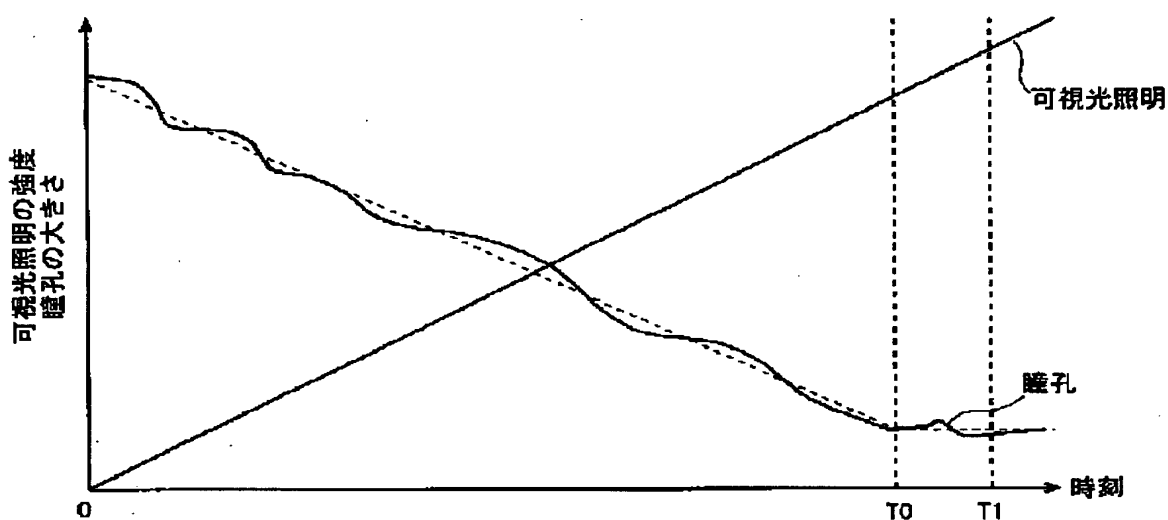
discernment system characterized by having the collating unit which collates the description data of the image of the eye which should be collated using the description data of the image of two or more eyes registered into said registration section.

Fig.1



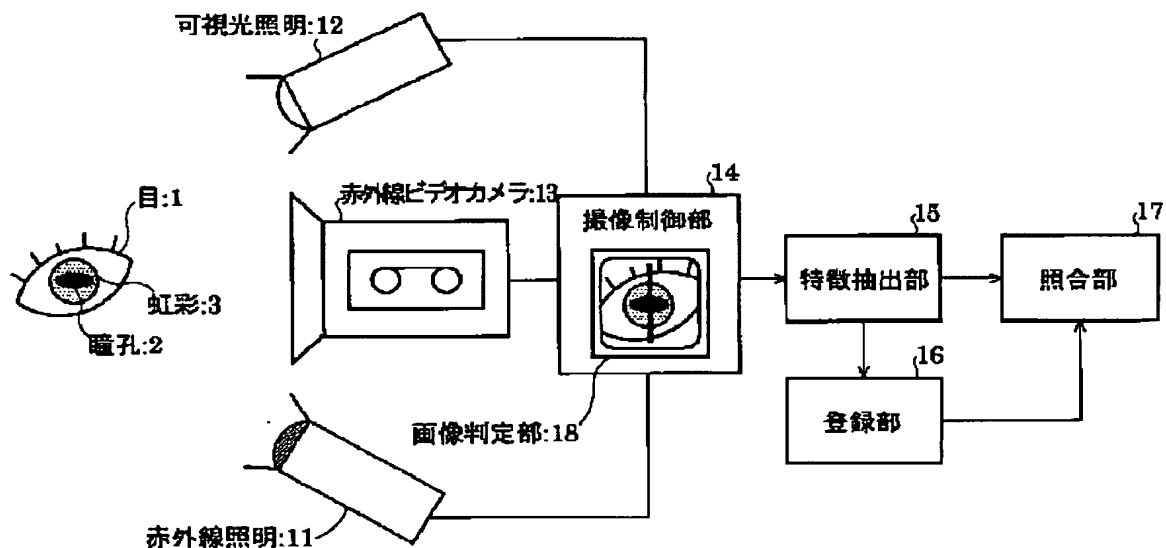
具体例1の個体識別システムの構成図

Fig.2



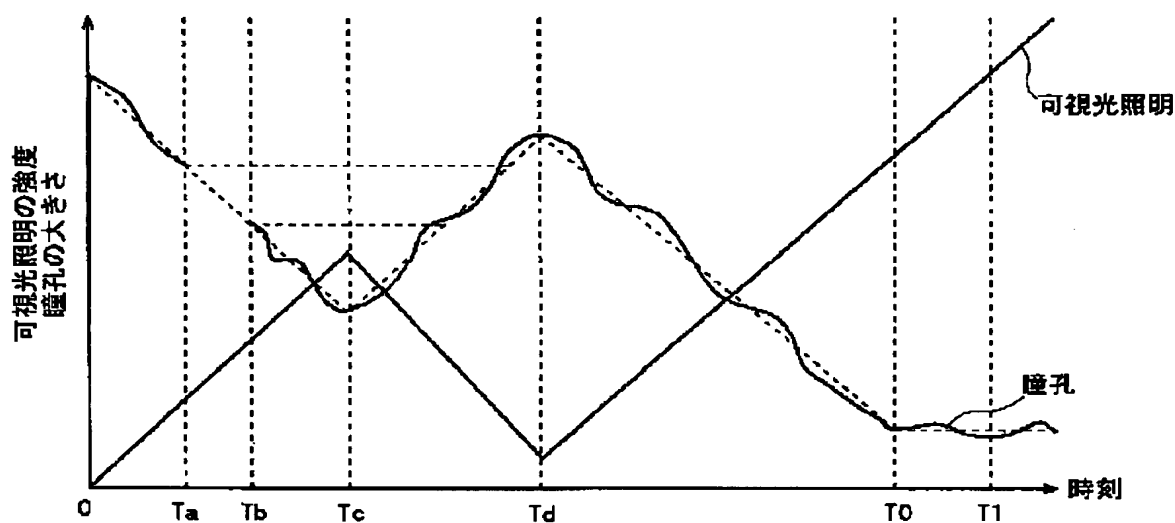
登録モード時の可視光照明の動作説明図

Fig.3



具体例2の個体識別システムの構成図

Fig.4



登録モード時の可視光照明の動作説明図